

1 PERVASIVE, PERSONAL DATA INTERACTIVITY OVER VOICE-GRADE  
2 CIRCUIT-SWITCHED CELLULAR NETWORKS

3 FIELD OF THE INVENTION

4 This invention is directed to the field of telephone  
5 networks. It is more particularly directed to cellular  
6 telephony as a means for remotely accessing and/or  
7 manipulating information and processes.

8 BACKGROUND

9 The use of cellular telephony has become an everyday  
10 experience for a lot of people. Cellular telephony  
11 permits users to have access to voice services (make  
12 calls, receive calls, access voice mail,  
13 teleconference, and so on) from practically everywhere  
14 without the need to be located next to a fixed wireline  
15 telephone, or wait for a telephone booth to become  
16 available.

17 However, the use of fixed-line telephony has some  
18 compelling advantages. A telephone number associated  
19 with a fixed telephone can be "tied" to the environment  
20 in which this telephone is located. Thus, the telephone  
21 number of a fixed-line telephone in a home can be used  
22 as an identifier of that home. This indeed happens  
23 today when, for example, various providers of  
24 residential services, e.g., water, electricity, and

1 CaTV public utilities, home heating oil and newspaper  
2 delivery services, and so on, use a telephone number as  
3 a distinguishing identifier of the recipient of the  
4 residential service. Even more so, the advent of the  
5 tone telephony signaling and the caller ID feature has  
6 permitted the development of a number of applications  
7 that permit one to use telephony as a means to access  
8 controllable services, like home automation facilities,  
9 remotely. For example, this is achieved by installing a  
10 telephony-enabled device in a home and connect it to an  
11 available public switched telephone network (PSTN) jack  
12 in the home. The ring signal generated when calling the  
13 telephone number for this PSTN jack could activate a  
14 device which then could receive commands remotely by  
15 sending it tones generated by a tone dialing telephone  
16 (not unlike the practically ubiquitous touch-tone,  
17 voice response, interactive services). Doing so, one  
18 can use such a system to, say, activate environmental  
19 control (heat/AC) services remotely.

20 One drawback for these purely telephony-based, home  
21 devices are that they have limited, if any,  
22 capabilities in providing "feedback" or status  
23 information for the devices that they control.  
24 Interactivity using visual means and in particular  
25 textual and graphics means could greatly enhance user  
26 experience in accessing remotely and controlling  
27 processes that interest various users.

28 Recently, a new generation of cellular phones have been  
29 introduced that take advantage of data cellular  
30 services, which is a distinct service from cellular

1 voice telephony, to display data information provided  
2 to them by cellular data service and content providers.  
3 This information is shown on small displays (typically,  
4 4 to 5 20-character lines) on these cellular phones.  
5 These cellular phones are some times called web-phones  
6 as the data services provided on them resemble the  
7 point-and-click experience and the information  
8 collecting and searching capabilities encountered on  
9 the Worldwide Web (WWW) using a web-browser on a  
10 notebook or desktop computer. Sometimes these phones  
11 are also called WAP phones, since a good number of them  
12 are using the Wireless Application Protocol (WAP)  
13 communications protocol suite for carrying the data  
14 services to the phones.

15 Data services on cellular phones focus primarily on  
16 e-commerce applications (purchasing of goods through  
17 "e-tailers" with presence on the Web), on-line banking,  
18 news, stock quote announcements, e-mail and messaging,  
19 audio/video downloads, and so on. All these services on  
20 the "wireless Web," a term that we would use without  
21 necessary implying the use of the WWW, WAP, etc.,  
22 protocols, allow the users of the wireless Web to  
23 contact businesses, and/or retrieve and manipulate  
24 business related information, and/or retrieve casual  
25 information (e.g., sports news broadcasting) from  
26 service and content providers.

27 It would be advantageous to further enhance the  
28 usability of the wireless Web by providing a  
29 capability to use one's personal communication devices,  
30 e.g., the cellular phone, to access and manipulate

1 information and processes that they do not necessarily  
2 fall in the traditional e-commerce/e-business category.  
3

#### 4 **SUMMARY OF THE INVENTION**

5 It is therefore an aspect of the present invention to  
6 provide methods and apparatus by which a user accesses  
7 that user's home automation system remotely and/or  
8 interactively over a long-haul wireless connection.

9 It is another aspect of this invention to provide  
10 visual interactive capability through one's personal  
11 device, using a cellular, voice telephony technology,  
12 like first and/or second generation cellular telephony  
13 systems, without the need to upgrade or modify the  
14 existing circuit switched wireless and wireline  
15 telephony infrastructure. Clearly, those skilled in the  
16 art could apply these concepts for additional instances  
17 of use of this invention without departing from the  
18 spirit of this invention.

#### 19 **BRIEF DESCRIPTION OF THE DRAWINGS**

20 These and other aspects, features, and advantages of  
21 the present invention will become apparent upon further  
22 consideration of the following detailed description of  
23 the invention when read in conjunction with the drawing  
24 figures, in which:

1 FIG. 1 shows an example of a communications scenario  
2 considered in a first embodiment of this invention  
3 using regular cellular and PSTN circuit switched  
4 technology to access an interactive home server and  
5 data distribution network;

6 FIG. 2 shows an example of communication protocol  
7 stacks involved in the first embodiment;

8 FIG. 3 shows an example of communication protocol  
9 stacks of a second example embodiment of this invention  
10 using regular cellular circuit switched network used to  
11 access the Intranet of an Internet Service Provider  
12 (ISP) through which the interactive home server and  
13 data distribution network is accessed; and

14 FIG. 4 shows an example of an apparatus in accordance  
15 with the present invention.

16 **DESCRIPTION OF THE INVENTION**

17 The present invention provides a means for a user  
18 to access that user's home automation system remotely  
19 and/or interactively over a long-haul wireless  
20 connection. It also provides methods and apparatus  
21 affording visual interactivity capability through one's  
22 personal device, using established cellular, voice  
23 telephony technologies, like first and second  
24 generation cellular telephony systems, without the need  
25 to upgrading or modifying the existing circuit switched  
26 wireless and wireline telephony infrastructure.  
27 Clearly, those skilled in the art could build

1 additional instances of this invention without  
2 departing the spirit of this invention. Even though  
3 this invention does not restrict itself only to this  
4 application, accessing one's home automation system  
5 remotely and interactively over a long-haul wireless  
6 connection provides a fine example for visualizing an  
7 objective of this invention.

8 FIG. 1 shows a first embodiment of an example of the  
9 present invention. The figure shows the access of a  
10 home data distribution network (HDN) through a cellular  
11 phone using no other infrastructure other than a  
12 regular circuit-switched cellular and PSTN networks.  
13 The cellular phone 101 is a web-phone able to show HTML  
14 web pages, like a smartphone from Kyocera. The phone  
15 can connect 102 to a home server with access to a web  
16 server 103 which is able to send, receive, and process  
17 HTML web pages. Through the web server access is  
18 provided to individual services 104, 105, 106 in the  
19 home through a home data distribution network (HDN)  
20 107, e.g., a power line distribution network, in-home  
21 wireless network, etc. The connection to the home  
22 server is over a regular voice circuit-switched  
23 cellular phone network 108 and PSTN 109 which they are  
24 connected through a gateway 110 that allows the  
25 wireless and wireline portions of the telephone network  
26 to inter-work. This embodiment of the invention  
27 requires minimal infrastructure support in that it  
28 relies on already ubiquitously deployed circuit  
29 switched wireless and wireline telephone networks.

FIG. 2 depicts the stacks of communication protocols involved in this first embodiment. In FIG. 2, we use the term client device, to denote a device onto which one can view a browser application through which the remote home server is accessed. The client device could be a cellular phone with web browsing capabilities, or a PDA with browsing capabilities attached to a cellular phone, and so on. The client device is generally a personal, portable device that either natively or through another personal, portable device can access and control data applications using a regular circuit-switched cellular telephone network. While it is easier to visualize the client device and the data applications that it interacts with as a cellular phone and web-enabled services, these are not requirements for this invention and those skilled in the art may implement the concepts of this invention using means other than just a cellular phone and/or a web-server. Thus the term cellular phone and client device are used interchangeably herein.

In this embodiment, the cellular phone runs a browser application 210 which in turn runs on top of the TCP/IP protocol stack 212. The Point-to-Point protocol (PPP) 214 adapts the packet oriented TCP/IP stack to the serial nature of the underlying communications networks 108 and 109. To physically connect to the telephone networks, a modem is required but it is not shown in the figure. The user of the cellular phone can dial-up directly into the server at home, which can be configured as a remote dial-up server, a feature that can be found on, for example, the Windows computer

1 operating system from Microsoft. The PPP protocol  
2 layers 214 and 215 in the cellular phone and the home  
3 server allow the authentication of the end-to-end  
4 communications path between these two devices. Also,  
5 the PPP layer at the home server 215 aids in the  
6 automatic configuration of the TCP/IP stack at the  
7 cellular phone 212, e.g., by assigning an IP address to  
8 it. This permits the complementary TCP/IP layers in the  
9 cellular phone 212 and the server 213 to connect with  
10 each other over the virtual communications pipe formed  
11 by the two PPP layers 214 and 215 and inter-operate.  
12 Finally, the browser application 210 on the cellular  
13 phone can access the browser server 211 on the home  
14 server through the virtual communications pipe formed  
15 by the TCP/IP layers 212 and 213.

16 The service access logic 216 that is accessible through  
17 the browser server 211 includes the software modules,  
18 sometimes referred to as service agents, that can be  
19 used to control the various services. These service  
20 agents may be web-enabled themselves and thus  
21 accessible directly from the browser on the cellular  
22 phone. Otherwise, these service agents are web-server  
23 technologies, like common-gateway interface (CGI) or  
24 Java servlets computer programs that enable the browser  
25 server to interact with the services. Note that these  
26 agents may be active, i.e., running, at all times, or  
27 stored in a directory, say, an Lightweight Directory  
28 Access Protocol (LDAP) directory and be retrieved and  
29 activated only when a user wants to access a particular  
30 service.



1 The service access logic communicates with services  
2 104, 106 using the home distribution network 107, which  
3 could be comprised a single network, say an 802.11  
4 wireless local area network (WLAN), or an aggregation  
5 of networks, e.g., an 802.11 WLAN, an X-10 network, a  
6 twisted-pair telephone network, a Bluetooth piconet,  
7 and so on. The home distribution communications  
8 protocol stack 217 supports the communication protocols  
9 that are required to access the services over the  
10 various services available through HDN 107. This stack  
11 is not specified here. However, this stack can be  
12 either a universal one executed by each of the  
13 controlled device, e.g., based on the Jini technology  
14 from Sun Microsystems, or a set of nonstandard  
15 protocols optimized for the communication with each of  
16 the different services to be controlled.

17 The embodiment in FIG. 2 shows dialing up the remote  
18 dial-up server directly through the concatenation of a  
19 cellular and PSTN networks. However, those skilled in  
20 the art, may employ a solution in which the remote  
21 dial-up server is associated with a telephone number  
22 from a cellular phone provider as well. Furthermore,  
23 for transporting telephony signaling and other control  
24 data between the cellular phone and the remote dial-up  
25 server, a data network may be used in between,  
26 employing a technology like voice-over-IP (VoIP) for  
27 doing so. Such solutions do not depart the spirit of  
28 this invention.

1 In the previous embodiment, we made a use of a voice,  
2 circuit-switched, wireless telephone network to dial-in  
3 through the regular PSTN directly to the home server.  
4 This approach is very attractive as it generally  
5 requires the user to "subscribe" to nothing more than  
6 the regular telephony service providers.

7 While the remote dial-up server capability is natively  
8 available or externally added on several popular  
9 computer operating systems, its activation requires a  
10 user to configure his/her home server. However, user  
11 configuration of home computers may not be the first  
12 choice in many people's home chores. But, if the  
13 computer is connected to an Intranet supported by an  
14 ISP then the perils of a user incorrectly configuring  
15 the remote dial-up server can be avoided. This is  
16 accomplished by placing the remote dial-up server away  
17 from the home computer, possibly at an ISP premise.

18 FIG. 3 shows an example embodiment for such a case. For  
19 simplicity, in the figure we show a telephone  
20 circuit-switched (CS) network 304 that represents the  
21 concatenation of the wireless 108, wireline 109 and  
22 gateway 110 components shown in Figures 1 and 2. The  
23 home server is connected to an Intranet 301 and it  
24 could be always on, like when it is connected to a  
25 digital subscriber loop (DSL) data service or CaTV data  
26 service. Note that always on is a logical state as  
27 modern home computers can operate in a standby mode and  
28 be activated and become fully operational when traffic  
29 destined to them is detected by their network interface  
30 card (NIC) 302, e.g., an 802.3 Ethernet card, or even

1 when one dials-in to the computer as is the case with  
2 the first embodiment.

3 FIG. 3 also shows dialing up the point-of-presence  
4 (PoP) 305 of the Intranet 301 of an ISP to which the  
5 home server is attached. Such ISPs are herein referred  
6 to as the home ISPs. Those skilled in the art may  
7 employ a solution in which one first dials up an ISP  
8 other than the home ISP. Such an ISP is herein  
9 referred to as the remote ISP. It is entirely possible  
10 for one to use the Intranet controlled by a remote ISP  
11 to connect to the Intranet controlled by the user's  
12 home ISP and then, eventually, connect to the user's  
13 home server. Such a solution does not depart from the  
14 spirit of this invention.

15 In this embodiment, the PPP protocol in the cellular  
16 phone terminates at a PPP server 303 within the  
17 Intranet prior to reaching the home server. This is a  
18 typical case experienced when one dials-up into a  
19 private, corporate, or public Internet service provider  
20 (ISP). The ISP Intranet is accessed over the  
21 circuit-switched telephone network 304 at a  
22 point-of-presence (PoP) location, which is typically  
23 represented by a telephone number to which a subscriber  
24 of the ISP calls to connect to the ISP's Intranet.  
25 Similarly to the first embodiment, the PPP entity on  
26 the ISP side 303, among other things, aids in the  
27 configuration of the TCP/IP layer 212 in the cellular  
28 phone so as to allow applications running on top of it  
29 to utilize the Intranet. In particular, the TCP/IP  
30 layer in the cellular phone 212 and the home server 213

1 form a logical data pipe that routes data from the  
2 browser application 210 to the browser server 211. The  
3 data could be routed through a number of link  
4 technologies over the cellular CS network and the  
5 Intranet until they finally reach the NIC in the home  
6 server 211. The various link technologies are  
7 transparent to the TCP/IP protocols and the  
8 applications running on them. Accessing of services  
9 through the HDN is done similarly to the first  
10 embodiment.

11 This embodiment points toward a service offering where  
12 a service provider provides access to one's home  
13 network. The service provider could be an ISP, or a  
14 third party. In either case, such a service is  
15 generally viable if secure communications between the  
16 cellular phone and the home server can be guaranteed.  
17 Thus, security processes, like secure socket layer  
18 (SSL), and/or secure IP protocol (IPSec) and/or link  
19 layer encryption and authentication, etc., should be  
20 added to secure the data path from the client to the  
21 home server. It is noted that in the first embodiment,  
22 security is less of an issue since one dials-in  
23 directly to the home server and authenticates oneself  
24 through the PPP service on the home server.

25 The above two embodiments, assume the use of a cellular  
26 phone that can use regular circuit-switched wireless  
27 technologies and be able to show HTML pages. Those  
28 skilled in the art, may connect other personal devices,  
29 e.g., a personal digital assistant (PDA), with  
30 web-browsing capabilities to the cellular phone prior

1 to accessing services remotely on a home server' or  
2 place some of the home server functionality within a  
3 data network outside the home. This allows several  
4 users to subscribe to a common, third-party, virtual  
5 home-server provider. Such systems are included in the  
6 spirit and concepts of the present invention which  
7 considers the use of a long-haul, circuit switched  
8 wireless network as the network-of-choice attachment  
9 for the client device. The device is able to interact  
10 with the home server and provide visual information in  
11 the form of text and/or graphics (including images) and  
12 possibly, but not necessarily, audible and visual  
13 feedback, e.g., by switching LED indicators on the  
14 client device ON and OFF.

15  
16 In alternate embodiments of the present invention,  
17 security credentials can be assigned to the user of the  
18 remote dial-up server, the home server, and/or the  
19 service access logic, shown in Figures 2 and 3, so that  
20 the services that are available to an individual may  
21 differ from one individual to another even though  
22 both individuals access the same physical server, using  
23 the same cellular phone.

24 The described embodiments represent application  
25 examples of instances covered by this invention. Those  
26 skilled in the art may apply this invention in ways  
27 different than the ones described without departing  
28 from the spirit and/or concepts of this invention.  
29 As used herein and in the following claims, the term  
30 "service" includes a logical operation that can be  
31 invoked to execute an action on behalf of another

1 entity. A remote service is a service that can be  
2 invoked remotely more particularly for this invention  
3 it includes a service that can be invoked over a  
4 wireless, circuit-switched, voice telephony system.  
5 Moreover, the term "serving entity" represents a  
6 physical entity, comprising a software and/or hardware  
7 elements, to which one can physically connect and make  
8 a request for execution of a service. The serving  
9 entity allows the physical execution of a service. For  
10 example, "controlling home environment" represents a  
11 service that does just that. With respect to Figures 1  
12 and 2, the computer 103 and the software programs 211  
13 and 216 that permit execution of the service  
14 "controlling home environment" includes the serving  
15 entity.

16 This invention may be formed as an apparatus for a user  
17 to interact with at least one service as shown in  
18 Figure 4 for the example embodiment shown in Figure 1.  
19 Figure 4 does not show the user using the cell phone  
20 attached to a cellular network accessing any specific  
21 service attached to a home distribution network as  
22 shown in Figure 1. It rather focuses on the apparatus  
23 in the middle of it all generically referred to as web  
24 server 103 in Figure 1. As shown within the dashed box  
25 in Figure 4, the apparatus comprises of several  
26 functional elements of which the (web) browser server  
27 is only one of them.

28 The apparatus includes a "client" port 401, which is a  
29 telephone port through which the apparatus attaches to  
30 the PSTN network 109. The apparatus includes a dial-in

1 service module that implements that dial-in logic. It  
2 includes the a PSTN modem to receive the incoming call  
3 from the client device in Figure 2 and also receive and  
4 transmit data over the PSTN network. The dial-in server  
5 module may also perform user authentication and trigger  
6 additional modules in the apparatus to process any  
7 incoming calls and requests from a client device. The  
8 protocol transport module 403 implements the protocols  
9 that are needed to transport data back and forth  
10 between the browser application in the client device,  
11 210 in Figure 2, and the browser server 404.

12 The browser server 404 is used to obtain, organize, and  
13 manipulate data that are received from or send to the  
14 client device through the protocol transport module.  
15 The data that are sent to the client device are to be  
16 displayed and viewed by the browser application in the  
17 client device. These data often include a list of  
18 services that are accessible remotely by the client  
19 device. This list of available services may reside in a  
20 service list repository 405. The data received by the  
21 browser application in the client device include a  
22 selection of at least one service that the user of the  
23 client device wants to control and also the action to  
24 be taken for the selected service, e.g., increase room  
25 temperature by 2 degrees Celsius. Upon the receipt of  
26 the action for a selected service, the browser server  
27 interacts with the particular service agent 406 that  
28 implements the control logic for controlling the  
29 selected service. The control signal generated by the  
30 service agent 406 leaves the apparatus through the  
31 "service" port 407. The service port 407 attaches the

1 apparatus to the home distribution network (HDN) 107  
2 via which the control signal is transmitted to the  
3 selected service. In reversing the order, the selected  
4 service may send status information over the HDN 107 to  
5 the service agent 406 through the "service" port. The  
6 service agent will process the status information and  
7 pass it to the browser server 404 to be sent for  
8 display by the browser application in the client  
9 device. The status information includes information to  
10 indicate whether the desired result has been achieved,  
11 e.g., the thermostat has received the change of  
12 temperature command and it has initiate the necessary  
13 actions required to change the room temperature.

14 Although as described, the apparatus described in  
15 Figure 4 relates to the embodiment of Figure 2. The  
16 modules of the apparatus in Figure 2 may be implemented  
17 employing different apparatus elements in other  
18 embodiments. For example, for the embodiment in Figure  
19 3, the dial-in server module is implemented at an  
20 apparatus at the premises of an ISP, while the browser  
21 server is implemented at an apparatus in a private  
22 house. Those skilled in the art may partition the  
23 modules of the apparatus in Figure 4 in different ways  
24 than the one described without departing from the  
25 spirit and scope of this invention.

26 This invention may be also be implemented as an  
27 apparatus for a user to interact with at least one  
28 remote service by implementing the steps of the methods  
29 of this invention. Thus, an example apparatus  
30 includes: user connecting means for said user



1 connecting to a serving entity using a client device  
2 attached to a wireless, circuit-switched, voice  
3 telephony network; user viewing means for obtaining and  
4 viewing a list of accessible remote services from said  
5 serving entity; user selecting means for selecting said  
6 at least one remote service from said list; and user  
7 access means for accessing and viewing said at least  
8 one remote service in obtaining desired results.

9 The present invention can be realized in hardware,  
10 software, or a combination of hardware and software. A  
11 visualization tool according to the present invention  
12 can be realized in a centralized fashion in one  
13 computer system, or in a distributed fashion where  
14 different elements are spread across several  
15 interconnected computer systems. Any kind of computer  
16 system - or other apparatus adapted for carrying out  
17 the methods and/or functions described herein - is  
18 suitable. A typical combination of hardware and  
19 software could be a general purpose computer system  
20 with a computer program that, when being loaded and  
21 executed, controls the computer system such that it  
22 carries out the methods described herein. The present  
23 invention can also be embedded in a computer program  
24 product, which comprises all the features enabling the  
25 implementation of the methods described herein, and  
26 which - when loaded in a computer system - is able to  
27 carry out these methods.

1 Computer program means or computer program in the  
2 present context include any expression, in any  
3 language, code or notation, of a set of instructions  
4 intended to cause a system having an information  
5 processing capability to perform a particular function  
6 either directly or after either or both of the  
7 following conversion to another language, code or  
8 notation, and/or reproduction in a different material  
9 form.

10 Thus the invention includes an article of manufacture  
11 which comprises a computer usable medium having  
12 computer readable program code means embodied therein  
13 for causing a function described above. The computer  
14 readable program code means in the article of  
15 manufacture comprises computer readable program code  
16 means for causing a computer to effect the steps of a  
17 method of this invention. Similarly, the present  
18 invention may be implemented as a computer program  
19 product comprising a computer usable medium having  
20 computer readable program code means embodied therein  
21 for causing a a function described above. The computer  
22 readable program code means in the computer program  
23 product comprising computer readable program code means  
24 for causing a computer to effect one or more functions  
25 of this invention. Furthermore, the present invention  
26 may be implemented as a program storage device readable  
27 by machine, tangibly embodying a program of  
28 instructions executable by the machine to perform  
29 method steps for causing one or more functions of this  
30 invention.

1 It is noted that the foregoing has outlined some of the  
2 more pertinent objects and embodiments of the present  
3 invention. This invention may be used for many  
4 applications. Thus, although the description is made  
5 for particular arrangements and methods, the intent and  
6 concept of the invention is suitable and applicable to  
7 other arrangements and applications. It will be clear  
8 to those skilled in the art that modifications to the  
9 disclosed embodiments can be effected without departing  
10 from the spirit and scope of the invention. The  
11 described embodiments ought to be construed to be  
12 merely illustrative of some of the more prominent  
13 features and applications of the invention. Other  
14 beneficial results can be realized by applying the  
15 disclosed invention in a different manner or modifying  
16 the invention in ways known to those familiar with the  
17 art.